

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

**0 208 541
A2**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 86305275.9

(22) Date of filing: 08.07.86

(51) Int. Cl.⁴: C10M 169/04 , C10M 105/02 ,
/(C10M169/04,105:02,129:76,1-
33:06,135:18,137:10),(C10N10/-
04,10:12,40:04,60:14)

(30) Priority: 08.07.85 JP 149630/85
08.07.85 JP 149631/85

(43) Date of publication of application:
14.01.87 Bulletin 87/03

(84) Designated Contracting States:
DE FR GB

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(54) Lubricant compositions.

(57) Lubricant compositions for use in traction drives are disclosed which incorporate a selected hydrocarbon type of base oils combined with specified amounts of selected zinc dialkyldithio phosphates, alkenyl succinimides or their boron derivatives, carboxylic acid esters of polyalcohols. These compositions provide traction drive apparatus with prolonged fatigue life, high oxidation stability, high shear stability, high traction coefficient, high wear resistance and rust-proofness.

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LUBRICANT COMPOSITIONS

This invention relates to fluid compositions suitable for use in traction drives.

Traction drive devices such as of ball-cone, cone-ring, wheel-disc, chain-sieve, toroidal and planetary roll types are designed to operate with power transmission that takes advantage of the rolling friction which develops as a result of a film of oil being hardened at the contacting surfaces. In general, lubricating oils for use in those traction drives should meet the following requirements.

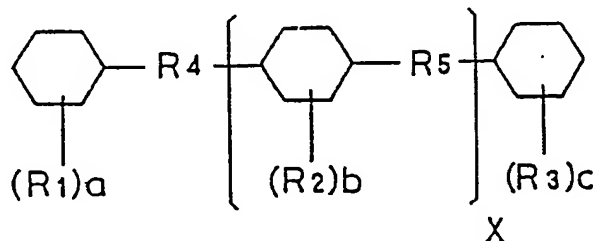
1. High coefficient of traction.
2. Enhanced oxidation stability, hence freedom from sludge formation and high shear stability.
3. Rust-proofness to prevent pitching and flaking at the contacting surfaces of the traction wheel.
4. High wear resistance to permit sufficient lubrication of bearings, wheels and actuators.

Known traction fluids are satisfactory in part, not in whole of the above requirements. Various additives have been proposed to compensate for the missing qualities. However, the use of such additives has in many instances resulted in reduced fatigue life of traction wheels, bearings and gears and also reduced traction coefficient.

It has now been found that fluid compositions of superior characteristics can be obtained for use in traction drives which incorporate a selected class of hydrocarbon compounds combined with certain dialkyldithio-zinc phosphates, alkenyl succinimides or their boron derivatives, and carboxylates of polyalcohols.

It is therefore the primary object of the present invention to provide improved traction fluid compositions which are capable of providing traction drive apparatus with prolonged fatigue life, high wear resistance, high traction coefficient, high oxidation and shear stability, rust-proofness and other characteristics desired to attain best traction performance.

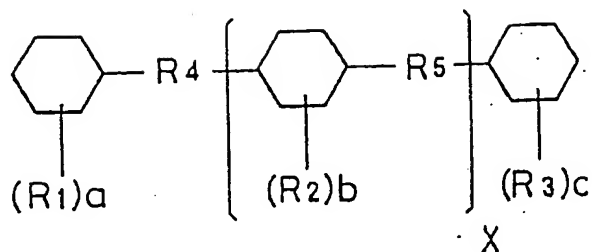
According to a first aspect of the invention, there is provided a lubricant composition for use in traction drives comprising: a base oil represented by the formula



where R_1 , R_2 and R_3 are alkyl groups of 1-4 carbon atoms, R_4 and R_5 are methylene, ethylene or trimethylene groups which may be substituted at the hydrogen atoms with an alkyl group of 1-4 carbon atoms, a , b and c are integers of 0-2, and x is an integer of 0 or 1; [I] a zinc dialkyldithio phosphate in an amount of 0.1-5 wt. %; [II] an alkenyl succinimide or its boron derivative in an

amount of 0.1-5 wt. %; and [III] a carboxylic acid partial ester of a polyalcohol of 3-6 carbon atoms in an amount of 0.01-5 wt. %, each of the amounts being based on the total composition.

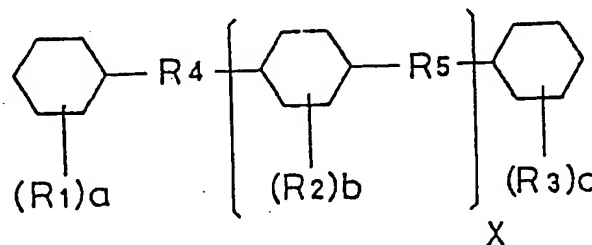
According to a second aspect of the invention, there is provided a lubricant composition for use in traction drives comprising: a base oil represented by the formula



where R_1 , R_2 and R_3 are alkyl groups of 1-4 carbon atoms, R_4 and R_5 are methylene, ethylene or trimethylene groups which may be substituted at the hydrogen atoms with an alkyl group of 1-4 carbon atoms, a , b and c are integers of 0-2, and x is an integer of 0 or 1; [I] a zinc dialkyldithio phosphate in an amount of 0.1-5 wt. %; [II] an alkenyl succinimide or its boron derivative in an amount of 0.1-5 wt. %; [III] a carboxylic acid partial ester of a polyalcohol of 3-6 carbon atoms

in an amount of 0.01-5 wt. %; and [IV] a polyolefin in an amount of 0.1-20 wt. %, the polyolefin resulting from the homo- or co-polymerization of olefins of 2-8 carbon atoms and having an average molecular weight of 200-10,000, each of the amounts being based on the total composition.

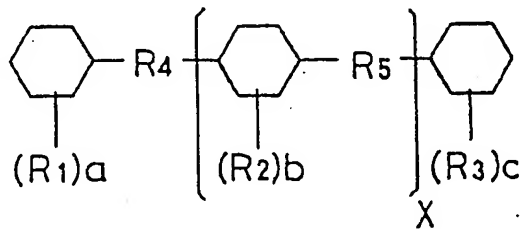
According to a third aspect of the invention, there is provided a lubricant composition for use in traction drives comprising: a base oil represented by the formula



where R_1 , R_2 and R_3 are alkyl groups of 1-4 carbon atoms, R_4 and R_5 are methylene, ethylene or trimethylene groups which may be substituted at the hydrogen atoms with an alkyl group of 1-4 carbon atoms, a , b and c are integers of 0-2, and x is an integer of 0 or 1; [I] a zinc dialkyldithio phosphate in an amount of 0.1-5 wt. %; [II] an alkenyl succinimide or its boron derivative in an amount of 0.1-5 wt. %; [III] a carboxylic acid partial ester of a polyalcohol of 3-6 carbon atoms

in an amount of 0.01-5 wt. %; and [V] at least one of molybdenum dithiophosphates and molybdenum dithiocarbamates in an amount of 0.1-10 wt. %, each of the amounts being based on the total composition.

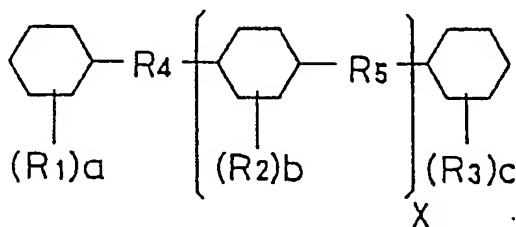
According to a fourth aspect of the invention, there is provided a lubricant composition for use in traction drives comprising: a base oil represented by the formula



where R_1 , R_2 and R_3 are alkyl groups of 1-4 carbon atoms, R_4 and R_5 are methylene, ethylene or trimethylene groups which may be substituted at the hydrogen atoms with an alkyl group of 1-4 carbon atoms, a, b and c are integers of 0-2, and x is an integer of 0 or 1; [I] a zinc dialkyldithio phosphate is an amount of 0.1-5 wt. %; [II] an alkenyl succinimide or its boron derivative in an amount of 0.1-5 wt. %; [III] a carboxylic acid partial ester of a polyalcohol of 3-6 carbon atoms in an amount of 0.01-5 wt. %; and [IV] a polyolefin in an

amount of 0.1-20 wt. %, the polyolefin resulting from the homo- or co-polymerization of olefins of 2-8 carbon atoms and having an average molecular weight of 200-10,000; and [V] at least one of molybdenum dithiophosphates and molybdenum dithiocarbamates in an amount of 0.1-10 wt. %, each of the amounts being based on the total composition.

Base oils suitable for the purpose of the present invention are hydrocarbon compounds represented by the formula

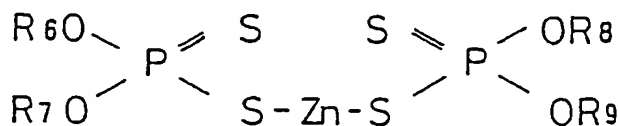


where R_1 , R_2 and R_3 are alkyl groups of 1-4 carbon atoms, R_4 and R_5 are methylene, ethylene or trimethylene groups which may be substituted at the hydrogen atoms with an alkyl group of 1-4 carbon atoms, a, b and c are integers of 0-2, and x is an integer of 0 or 1.

Eligible substituting groups for R_1 , R_2 and R_3 are methyl, ethyl, propyl and butyl, amongst which methyl and ethyl are particularly preferred. Eligible R_4 and R_5 groups are methylene, methylmethylene (ethylidene), dimethylmethylene, ethylene, methylethylene, 1,1-dimethylethylene, 1,2-dimethylethylene, 1,1,2-trimethylethylene, tetramethylethylene, trimethylene, 1-methyltrimethylene, 2-methyltrimethylene, 1,1-dimethyltrimethylene, 1,2-dimethyltrimethylene, 1,3-dimethyltrimethylene, 2,2-dimethyltrimethylene, 1,1,2-trimethyltrimethylene, 1,1,3-trimethyltrimethylene, 1,2,2-trimethyltrimethylene, 1,2,3-trimethyltrimethylene, 1,1,2,2-tetramethyltrimethylene, 1,1,2,3-tetramethyltrimethylene, 1,1,3,3-tetramethyltrimethylene and 1,2,2,3-tetramethyltrimethylene.

Specific examples of the base oils include dicyclohexylmethane, 1,1-dicyclohexylethane, 1,2-dicyclohexylethane, 1,2-dicyclohexylpropane, 1,3-dicyclohexylpropane, 2,2-dicyclohexylpropane, 1,2-dicyclohexyl-2-methylpropane, 1,3-dicyclohexylbutane, 1,3-dicyclohexyl-3-methylbutane, 1,3-dicyclohexyl-2,3-dimethylbutane, 2,3-dicyclohexyl-2,3-dimethylbutane, 2,4-dicyclohexylpentane, 2,4-dicyclohexyl-2-methylpentane, bis(cyclohexylmethyl)cyclohexane, bis(1-cyclohexylethyl)cyclohexane and bis(1-methyl-2-cyclohexylethyl)cyclohexane, substituted compounds thereof in which one or two methyl or ethyl groups are bonded to the hydrogen atoms of the cyclohexyl ring, and combinations thereof. Particularly preferred among those base oils are 1-cyclohexyl-1-methylcyclohexylethane, 1-cyclohexyl-1-ethylcyclohexylethane, 1-cyclohexyl-1-dimethylcyclohexylethane, bis(1-cyclohexylethyl)methylcyclohexane, bis(1-cyclohexylethyl)ethylcyclohexane, bis(1-cyclohexylethyl)dimethylcyclohexane and 2,4-dicyclohexyl-2-methylpentane, and combinations thereof.

Zinc dialkyldithio phosphates useful as component [I] hereunder are compounds represented by the formula



where R₁, R₂, R₃ and R₄ are alkyl or alkylaryl groups having a carbon number of 3 -22, preferably 3 -15, and may be the same or different. Particularly preferred alkyl and alkylaryl groups are isopropyl, sec-butyl, isobutyl, n-amyl, isoamyl, 4-methylpentyl, 2-ethylhexyl, decyl, isodecyl, nonylphenyl and dodecylphenyl.

The amount of component [I] to be added should be in the range of 0.1 - 5 wt. %, preferably 0.5 -3 wt. %, based on the total composition. Smaller amounts than 0.1 wt. % would fail to give sufficient wear resistance and oxidation stability. Greater amounts than 5 wt. % would result in reduced rolling fatigue life and traction coefficient.

Alkenyl succinimides and their boron derivatives are useful as component [II] in the invention. The alkenyl succinimides may be obtained by reaction of polyolefins with maleic anhydride and by subsequent conversion of the resulting intermediates into the form of imides by reaction with amines. Examples of the polyolefins are those resulting from the homo- and co-polymerization of olefins of 2 -30 carbon atoms such as ethylene, propylene, butene, pentene, hexene, heptene, octene, nonene, decene and dodecene, and also from the co-polymerization of those olefins with aromatic olefins such as styrene. The molecular weight of the polyolefins is between 300 and 5,000. Examples of the amines to be here used include monoamines such as methylamine, ethylamine, propylamine, butylamine, pentylamine, hexylamine, heptylamine and octylamine, polyamines such as ethylenediamine, propylenediamine, N,N'-dimethylpropylenediamine, trimethylenediamine, N,N'-dihexyltrimethylenediamine, decamethylenediamine, di(trimethylene)triamine, di(heptamethylene)triamine, triethylenetetraamine, tripropylenetetraamine, tetraethylenepentaamine, pentaethylenehexaamine, imidazoline, methylimidazoline, bis(aminoethyl)imidazoline, pyrimidine, aminopropylpiperazine and bis(aminoethyl)piperazine, and hydroxy-substituted amines such as N-mono(hydroxyethyl)ethylenediamine, N,N'-bis(hydroxyethyl)ethylenediamine, N-mono(hydroxypropyl)diethylenetriamine and N,N'-bis(hydroxypropyl)tetraethylenepentaamine.

The borides or boron derivatives of the above alkenyl succinimides are obtainable by reaction of such succinimides with boron compounds selected for example from boron oxide, boron oxide hydrates, boron trifluoride, boron trichloride, boron tribromide, alkyl or aryl borons, boric acid, metaboric acid and tetraboric acid, esters of these boric acids with alcohols and phenols and ammonium salts thereof. The boron derivatives may be synthesized by numerous methods disclosed for example in U. S. Patent Nos. 3,281,428, 3,282,955, 3,284,410, 3,284,409, 3,344,069 and 3,533,945,

Japanese Patent Publication Nos. 42-8013, 42-8014, 47-45161 and 47-45162, and Japanese Patent Application (Kokai) Nos. 51-52381, 51-130408 and 54-87705.

The amount of component [II] to be added should be in the range of 0.1 -5 wt. %, preferably 0.5 -3 wt. %, based on the total composition. Smaller amounts than 0.1 wt. % would invite insufficient oxidation stability. Greater amounts than 5 wt. % would result in reduced rolling fatigue life, traction coefficient and wear resistance.

Carboxylic acid partial esters of polyalcohols of 3 -6 carbon atoms are useful as component [III] in the invention. Examples of the polyalcohols include glycerine [C₃H₈(OH)₃], pentaerythritol [C₅H₈(OH)₄], sorbitol [C₆H₁₄(OH)₆] and sorbitan [C₆H₁₂O(OH)₄]. Examples of the carboxylic acids are those having a carbon number of 8 -22, preferably 12 -18, and including decanoic acid (capric acid), undecanoic acid, dodecanoic acid (lauric acid), tridecanoic acid, tetradecanoic acid (myristic acid), pentadecanoic acid, hexadecanoic acid (palmitic acid), heptadecanoic acid (margaric acid), octadecanoic acid (stearic acid), nonadecanoic acid, eicosanoic acid (arachidic acid), heneicosanoic acid, docosanoic acid (behenic acid), dodecenoic acid, tetradecenoic acid, hexadecenoic acid, octadecenoic acid (oleic acid), dodecadienoic acid, tetradecadienoic acid, hexadecadienoic acid and octadecadienoic acid (linoleic acid).

Specific examples of component [III] include glycerine dodecanoic acid monoester - (monoglyceride laurate), glycerine hexadecanoic acid monoester (monoglyceride palmitate), glycerine octadecanoic acid monoester (monoglyceride stearate), glycerine octadecenoic acid monoester - (monoglyceride oleate), pentaerythritol dodecanoic acid monoester (pentaerythritol monolaurate), pentaerythritol hexadecanoic acid monoester (pentaerythritol monopalmitate), pentaerythritol octadecanoic acid monoester (pentaerythritol monostearate), pentaerythritol octadecenoic acid monoester (pentaerythritol monooleate), sorbitol dodecanoic acid monoester (sorbitol monolaurate), sorbitol hexadecanoic acid monoester (sorbitol monopalmitate), sorbitol octadecanoic acid monoester (sorbitol monostearate), sorbitol octadecenoic acid monoester (sorbitol monooleate), sorbitan dodecanoic acid monoester (sorbitan monolaurate), sorbitan hexadecanoic acid monoester (sorbitan monopalmitate), sorbitan octadecanoic acid monoester (sorbitan monostearate), sorbitan octadecenoic acid monoester (sorbitan monooleate), sorbitan octadecanoic acid triester - (sorbitan tristearate) and sorbitan octadecenoic acid triester (sorbitan trioleate), and combinations thereof.

The amount of component [III] to be added should be in the range of 0.01 -5 wt. %, preferably 0.1 -3 wt. %, based on the total composition. Smaller amounts than 0.01 wt. % would be insufficient for rust-proofness. Greater amounts than 5 wt. % would induce reduced rolling fatigue life and traction coefficient.

A first embodiment of the invention provides lubricant compositions in which components [I] to - [III] are combined with base oils. According to a second embodiment of the invention, selected polyolefins are further incorporated to build dynamic viscosity and shear stability.

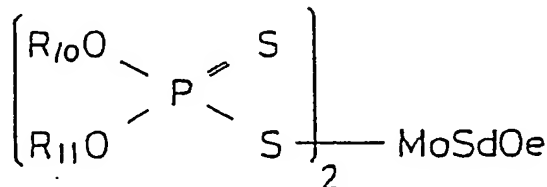
Polyolefins eligible as component [IV] hereunder are those having an average molecular weight of 200 -10,000, preferably 1,000 -4,000, and obtained by the homo-and co-polymerization of olefins selected for example from ethylene, propylene, 1-butene and isobutylene with use of a Friedel-Crafts catalyst such as aluminum chloride, magnesium chloride, boron fluoride or titanium tetrachloride, or a complex compound thereof, if nec-

essary in combination with a co-catalyst such as an organic halide or hydrochloric acid. Polybutene, polyisobutylene, ethylene-propylene copolymer, ethylene-1-butene copolymer and ethylene-propylene-1-butene copolymer are particularly preferred.

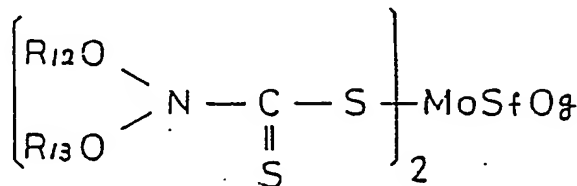
The amount of component [IV] to be added should be in the range of 0.1 -20 wt. %, preferably 1 -10 wt. %, based on the total composition. Smaller amounts than 0.1 wt. % would be ineffective for viscosity buildup. Greater amounts than 20 wt. % would lead to reduced traction coefficient.

Third and fourth embodiments of the invention are intended to make the resulting compositions more highly resistant to wear and longer in rolling fatigue life by further addition of selected molybdenum compounds.

Molybdenum compounds suitable as component [V] in the invention are one or more of molybdenum dithiophosphates and molybdenum dithiocarbamates represented respectively by the formulae



where R_{10} and R_{11} are alkyl, cycloalkyl, alkylcycloalkyl, aryl, alkylaryl or arylalkyl groups of 1 -24 carbon atoms, d is $0 < d \leq 4$, and e is $0 \leq e < 4$ in which $d + e = 4$, and



where R_{12} and R_{13} are as defined above, f is $0 < f \leq 4$, and g is $0 \leq g < 4$ in which $f + g = 4$.

Eligible R_{10} to R_{13} groups are methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, dodecyl, tetradecyl, hexadecyl, octadecyl, eicosyl, docosyl, tetracosyl, cyclopentyl, cyclohexyl, methylcyclohexyl, ethylcyclohexyl, dimethylcyclohexyl, cycloheptyl, phenyl, tolyl, xylol, ethylphenyl, propylphenyl, butylphenyl, pen-

tylphenyl, hexylphenyl, heptylphenyl, octylphenyl, nonylphenyl, decylphenyl, dodecylphenyl, tetradecylphenyl, hexadecylphenyl, octadecylphenyl, benzyl and phenethyl.

Specific examples of component [V] include molybdenum diethyldithiophosphate sulfide, molybdenum dipropyldithiophosphate sulfide, molybdenum dipropyldithiophosphate sulfide, molybdenum dibutyldithiophosphate sulfide, molybdenum dipentyldithiophosphate sulfide, molybdenum dihexyl-

dithiophosphate sulfide, molybdenum dioctyl-
 dithiophosphate sulfide, molybdenum didecyl-
 dithiophosphate sulfide, molybdenum didecyl-
 dithiophosphate sulfide, molybdenum di-
 (butylphenyl)dithiophosphate sulfide, molybdenum-
 (nonylphenyl)dithiophosphate sulfide, oxymolyb-
 denum diethyldithiophosphate sulfide, oxymolyb-
 denum dipropyldithiophosphate sulfide, oxymolyb-
 denum dibutyldithiophosphate sulfide, oxymolyb-
 denum dipentyldithiophosphate sulfide, oxymolyb-
 denum dihexyldithiophosphate sulfide, oxymolyb-
 denum dioctyldithiophosphate sulfide, oxymolyb-
 denum didecyldithiophosphate sulfide, oxymolyb-
 denum didodecyldithiophosphate sulfide, oxymolybdenum di(butylphenyl)dithiophosphate sul-
 fide, oxymolybdenum di(nonylphenyl)-
 dithiophosphate sulfide, molybdenum diethyl-
 dithiocarbamate sulfide, molybdenum dipropyl-
 dithiocarbamate sulfide, molybdenum dibutyl-
 dithiocarbamate sulfide, molybdenum dihexyl-
 dithiocarbamate sulfide, molybdenum dioctyl-
 dithiocarbamate sulfide, molybdenum didecyl-
 dithiocarbamate sulfide, molybdenum didodecyl-
 dithiocarbamate sulfide, molybdenum di-
 (butylphenyl)dithiocarbamate sulfide, molybdenum
 di(nonylphenyl)dithiocarbamate sulfide, oxymolyb-
 denum diethyldithiocarbamate sulfide, oxymolyb-
 denum dipropyldithiocarbamate sulfide, oxymolyb-
 denum dibutyldithiocarbamate sulfide, oxymolyb-
 denum dipentyldithiocarbamate sulfide, oxymolyb-
 denum dihexyldithiocarbamate sulfide, oxymolyb-
 denum dioctyldithiocarbamate sulfide, oxymolyb-
 denum didecyldithiocarbamate sulfide, oxymolyb-
 denum didodecyldithiocarbamate sulfide, oxymolybdenum di(butylphenyl)dithiocarbamate sul-
 fide and oxymolybdenum di(nonylphenyl)-
 dithiocarbamate, and combinations thereof. Particu-
 larly preferred are combinations of phosphates,
 molybdenum dithiophosphates and molybdenum
 dithiocarbamates.

The amount of component [V] to be added
 should be in the range of 0.1 -10 wt. %, preferably
 0.3 -5 wt. %, based on the total composition.
 Smaller amounts than 0.1 wt. % would fail to pro-
 duce sufficient wear resistance and rolling fatigue
 life. Greater amounts than 10 wt. % would result in
 reduced traction coefficient and rolling fatigue life.

There may be used additives such as metallic
 cleaning agents including alkali metal sulfonates
 and alkaline earth metal sulfonates, anticorrosive
 agents, extreme pressure agents, viscosity index
 improvers, rust preventives and the like.

The invention will be further described by way
 of the following examples.

Inventive Examples 1 -8

Numerous tractive fluid compositions according
 to the invention were formulated and prepared as
 per Table 1.

Comparative Examples 1 -2

Two controls were prepared, one control using
 only a base oil of the invention, and the other being
 commercially available.

Performance test was made with the results
 shown in Table 2.

Dynamic Viscosity

Measurement was made in accordance with
 ASTM D 445 (Standard Test Method for Kinematic
 Viscosity of Transparent and Opaque Liquids).

Traction Coefficient

Four-cylinder rolling friction tester was used
 with rolling speed 310 cm/second, load 90 kg/mm²
 and slip rate 2 %.

Oxidation Stability

JIS K 2514 (Testing Method for Oxidation Sta-
 bility of Lubricants for Internal Combustion Engine
 Oils) was followed with temperature 165.5°C and
 time 72 hours. Viscosity ratio at 40°C was deter-
 mined.

Shear Stability

Test was made in accordance with ASTM D
 2603 (Standard Test Method for Sonic Shear Sta-
 bility of Polymer-Containing Oils) with sonic radi-
 ation 10 KH_z, temperature 40°C and time 30 min-
 utes. Viscosity reduction at 40°C was determined.

Wear Resistance

ASTM D 2266 was followed with speed 1,500
 ppm, load 40 kgf and time 2 hours, using four
 balls. Wear scar diameter was measured.

Fatigue Life

IP 305 (Testing Method for Uni-Steel Rolling
 Fatigue) was followed. Length of time required for
 L₁₀:90 % life was measured.

Rust Prevention

This test was made in accordance with ASTM D 665 (Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water).

It is to be noted that the compositions representing Inventive Examples 1 -8 are highly satisfactory in respect of all the performance characteristics tested. The controls of Comparative Examples 1 -2 were inadequate in wear resistance, fatigue life, shear stability and rust-proofness.

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Table 1

Example	Formulation (wt. %)					
	base oil	component [I]	component [II]	component [III]	component [IV]	component [V]
Inventive Example 1	2,4-dicyclohexyl-2-methylpentane	zinc di-2-ethylhexyldithio phosphate (1.0)	alkenyl succinimide* (2.0)	sorbitan monolaurate (0.1)	--	--
Inventive Example 2	2,4-dicyclohexyl-2-methylpentane	zinc dinonylphenyldithio phosphate (2.0)	alkenyl succinimide boride (1.0)	sorbitan monooleate (0.1)	--	--
Inventive Example 3	bis(1-cyclohexylethyl)-dimethylcyclohexane	zinc diisopropyl-dithio phosphate (1.0)	alkenyl succinimide boride (1.0)	pentaerythritol monooleate (0.1)	--	--
Inventive Example 4	2,4-dicyclohexyl-2-methylpentane	zinc di-2-ethylhexyldithio phosphate (1.0)	alkenyl succinimide (1.0)	pentaerythritol monoisostearate (0.2)	polybutene A (4.0)	--
Inventive Example 5	2,4-dicyclohexyl-2-methylpentane	zinc didecyl-dithiophosphate (2.0)	alkenyl succinimide boride (1.0)	sorbitan monoisostearate (0.1)	ethylene-propylene copolymer (4.0)	--
Inventive Example 6	bis(1-cyclohexylethyl)-dimethylcyclohexane	zinc diisobutyl-dithio phosphate (1.0)	alkenyl succinimide (2.0)	pentaerythritol monolaurate (0.2)	polybutene B (8.0)	--

Table 1 (continued)

Example	Formulation (wt. %)				
	base oil	component [I]	component [II]	component [III]	component [IV]
Inventive Example 7	2,4-dicyclohexyl-2-methylpentane	zinc diisopropyl-dithio-phosphate (1.0)	alkenyl succinimide boride (1.0)	sorbitan monolaurate (0.1)	--
Inventive Example 8	2,4-dicyclohexyl-2-methylpentane	zinc dinonyl-phenyldithio-phosphate (2.0)	alkenyl succinimide boride (1.0)	pentaerythritol monoiso-stearate (0.2)	oxymolybdenum di(2-ethyl-hexyl)dithio-phosphate (0.3)
Comparative Example 1	2,4-dicyclohexyl-2-methylpentane	--	--	--	oxymolybdenum dibutyldithio-carbamate (0.5)
Comparative Example 2	commercial product				

* alkenyl succinimide: compound derived by reaction of polyisobutylene (molecular weight 1,000) substituted succinic anhydride with N-octadecyltrimethylenediamine

* alkenyl succinimide boride: compound derived by reaction of polyisobutylene (molecular weight 1,000) substituted succinic anhydride with N-octadecyltrimethylenediamine and boric acid

* polybutene A: average molecular weight 2,700

* polybutene B: average molecular weight 1,350

* ethylene-propylene copolymer: average molecular weight 3,700

Table 2

Example	P e r f o r m a n c e						
	dynamic viscosity (cSt, @40°C)	traction coefficient	oxidation stability (viscosity ratio, @40°C)	shear stability (viscosity reduc- tion, @40°C)	wear resistance (wear scar diameter, mm)	fatigue life (L ₁₀ , hr)	rust- proofness
Inventive Example 1	21.0	0.087	1.0	0.0	0.53	7.2	rustless
Inventive Exampel 2	20.9	0.088	1.0	0.0	0.57	7.0	"
Inventive Example 3	20.9	0.087	1.0	0.0	0.55	7.3	"
Inventive Example 4	30.2	0.088	1.0	0.1	0.41	8.3	"
Inventive Example 5	32.5	0.087	1.0	0.1	0.60	8.2	"
Inventive Example 6	31.6	0.087	1.0	0.1	0.46	8.4	"
Inventive Example 7	21.0	0.087	1.2	0.0	0.51	9.1	"
Inventive Example 8	30.1	0.087	1.0	0.1	0.40	9.0	"
Comparative Example 1	20.6	0.086	1.2	0.0	0.76	6.5	extremely rusted
Comparative Example 2	29.7	0.086	1.2	14.2	1.45	7.3	"

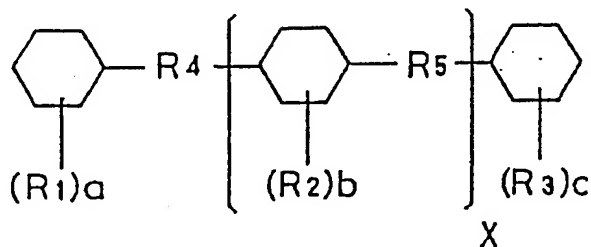
pyrimidine, aminopropylpiperazine, bis(aminoethyl)piperazine, N-mono(hydroxyethyl)ethylenediamine, N,N'-bis(hydroxyethyl)ethylenediamine, N-mono(hydroxypropyl)diethylenetriamine and N,N'-bis(hydroxypropyl)tetraethylenepentaamine.

6. The lubricant composition according to claim 4 wherein said component [II] is a compound derived by reaction of said alkenyl succinimide with a boron compound selected from the group consisting of boron oxide, boron oxide hydrates, boron trifluoride, boron trichloride, boron tribromide, alkyl borons, aryl borons, boric acid, metaboric acid and tetraboric acid, and esters of said boric acids with alcohols and phenols and ammonium salts thereof.

7. The lubricant composition according to claim 1 wherein said component [III] is selected from the group consisting of glycerine dodecanoic acid

monoester, glycerine hexadecanoic acid monoester, glycerine octadecanoic acid monoester, glycerine octadecenoic acid monoester, pentaerythritol dodecanoic acid monoester, pentaerythritol hexadecanoic acid monoester, pentaerythritol octadecanoic acid monoester, pentaerythritol octadecenoic acid monoester, sorbitol dodecanoic acid monoester, sorbitol hexadecanoic acid monoester, sorbitol octadecanoic acid monoester, sorbitol octadecenoic acid monoester, sorbitan dodecanoic acid monoester, sorbitan hexadecanoic acid monoester, sorbitan octadecanoic acid monoester, sorbitan octadecenoic acid monoester, sorbitan octadecanoic acid triester and sorbitan octadecenoic acid triester and combinations thereof.

8. A lubricant composition for traction drives comprising: a base oil represented by the formula

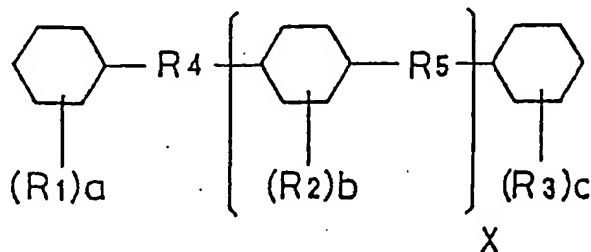


where R_1 , R_2 and R_3 are alkyl groups of 1-4 carbon atoms, R_4 and R_5 are methylene, ethylene or trimethylene groups which may be substituted at the hydrogen atoms with an alkyl group of 1-4 carbon atoms, a , b and c are integers of 0-2, and x is an integer of 0 or 1; [I] a zinc dialkyldithio phosphate in an amount of 0.1-5 wt. %; [II] an alkenyl succinimide or its boron derivative in an amount of 0.1-5 wt. %; [III] a carboxylic acid partial ester of a polyalcohol of 3-6 carbon atoms in an amount of 0.01-5 wt. %; and [IV] a polyolefin in an amount of 0.1-20 wt. %, said polyolefin

resulting from the homo- or co-polymerization of olefins of 2-8 carbon atoms and having an average molecular weight of 200-10,000, each said amount being based on the total composition.

9. The lubricant composition according to claim 8 wherein said component [IV] is selected from the group consisting of polybutene, polyisobutylene, ethylenepropylene copolymer, ethylene-1-butene copolymer and ethylene-propylene-1-butene copolymer.

10. A lubricant composition for traction drives comprising: a base oil represented by the formula



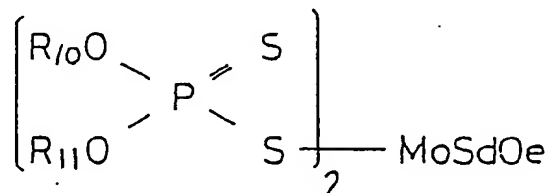
where R_1 , R_2 and R_3 are alkyl groups of 1-4 carbon atoms, R_4 and R_5 are methylene, ethylene or trimethylene groups which may be substituted at

the hydrogen atoms with an alkyl group of 1-4 carbon atoms, a , b and c and x is an integer of 0 or 1; [I] a zinc dialkyldithio

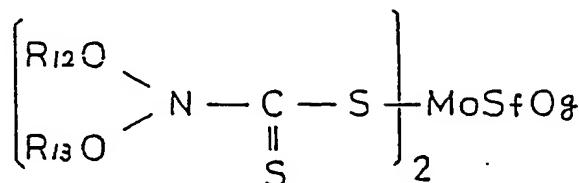
phosphate in an amount of 0.1 -5 wt. %; [II] an alkenyl succinimide or its boron derivative in an amount of 0.1 -5 wt. %; [III] a carboxylic acid partial ester of a polyalcohol of 3 -6 carbon atoms in an amount of 0.01 -5 wt. %; and [V] at least one of molybdenum dithiophosphates and molybdenum

dithiocarbamates in an amount of 0.1 -10 wt. %, each said amount being based on the total composition.

11. The lubricant composition according to claim 11 wherein said component [V] is a molybdenum dithiophosphate represented by the formula



where R_{10} and R_{11} are alkyl, cycloalkyl, alkylcycloalkyl, aryl, alkylaryl or arylalkyl groups of 1 -24 carbon atoms, d is 0 d 4, and e is 0 e 4 in which d + e = 4, and/or a molybdenum dithiocarbamate represented by the formula

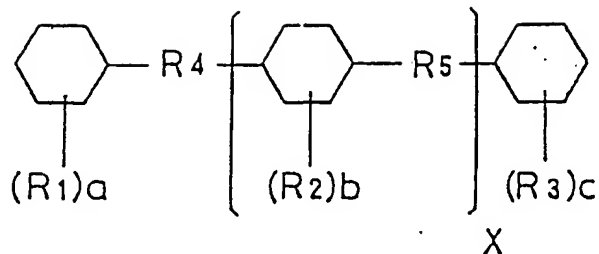


where R_{12} and R_{13} are as defined above, f is 0 f 4, and g is 0 g 4 in which f + g = 4.

12. The lubricant composition according to claim 11 wherein said component [V] is selected from the group consisting of molybdenum diethyldithiophosphate sulfide, molybdenum dipropyldithiophosphate sulfide, molybdenum dipropyldithiophosphate sulfide, molybdenum dibutyldithiophosphate sulfide, molybdenum dipentyldithiophosphate sulfide, molybdenum dihexyldithiophosphate sulfide, molybdenum dioctyldithiophosphate sulfide, molybdenum didecyldithiophosphate sulfide, molybdenum didodecyldithiophosphate sulfide, molybdenum di-(butylphenyl)dithiophosphate sulfide, molybdenum (nonylphenyl)dithiophosphate sulfide, oxymolybdenum diethyldithiophosphate sulfide, oxymolybdenum dipropyldithiophosphate sulfide, oxymolybdenum dibutyldithiophosphate sulfide, oxymolybdenum dipentyldithiophosphate sulfide, oxymolybdenum dihexyldithiophosphate sulfide, oxymolybdenum dioctyldithiophosphate sulfide, oxymolybdenum didecyldithiophosphate sulfide, oxymolybdenum didodecyldithiophosphate sulfide, oxymolybdenum di-(butylphenyl)dithiophosphate sulfide, oxymolybdenum di(nonylphenyl)dithiophosphate sulfide, and combinations thereof.

35 fide, oxymolybdenum di(nonylphenyl)dithiophosphate sulfide, molybdenum diethyldithiocarbamate sulfide, molybdenum dipropyldithiocarbamate sulfide, molybdenum dibutyldithiocarbamate sulfide, molybdenum dihexyldithiocarbamate sulfide, molybdenum dioctyldithiocarbamate sulfide, molybdenum didecyldithiocarbamate sulfide, molybdenum didodecyldithiocarbamate sulfide, molybdenum di-(butylphenyl)dithiocarbamate sulfide, molybdenum di(nonylphenyl)dithiocarbamate sulfide, oxymolybdenum diethyldithiocarbamate sulfide, oxymolybdenum dipropyldithiocarbamate sulfide, oxymolybdenum dibutyldithiocarbamate sulfide, oxymolybdenum dipentyldithiocarbamate sulfide, oxymolybdenum dihexyldithiocarbamate sulfide, oxymolybdenum dioctyldithiocarbamate sulfide, oxymolybdenum didecyldithiocarbamate sulfide, oxymolybdenum didodecyldithiocarbamate sulfide, oxymolybdenum di-(butylphenyl)dithiocarbamate sulfide and oxymolybdenum di(nonylphenyl)dithiocarbamate, and combinations thereof.

13. A lubricant composition for traction drives comprising: a base oil represented by the formula



where R_1 , R_2 , and R_3 are alkyl groups or 1-4 carbon atoms, R_4 and R_5 are methylene, ethylene or trimethylene groups which may be substituted at the hydrogen atoms with an alkyl group of 1-4 carbon atoms, a , b and c are integers of 0-2, and x is an integer of 0 or 1; [I] a zinc dialkyldithio phosphate in an amount of 0.1-5 wt. %; [II] an alkenyl succinimide or its boron derivative in an amount of 0.1-5 wt. %; [III] a carboxylic acid partial ester of a polyalcohol of 3-6 carbon atoms

in an amount of 0.01-5 wt. %; [IV] a polyolefin in an amount of 0.1-20 wt. %, said polyolefin resulting from the homo- or co-polymerization of olefins of 2-8 carbon atoms and having an average molecular weight of 200-10,000; and [V] at least one of molybdenum dithiophosphates and molybdenum dithiocarbamates in an amount of 0.1-10 wt. %, each said amount being based on the total composition.

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